THE ENGINEER.

The British Industries Fair at Birmingham.

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As we hinted in our preliminary notice last week, the British Industries Fair at Birmingham shows this year a great advance on any of its predecessors, but we feel that it is only proper, before going on to continue our description of the exhibits, that we should make some further brief reference to its general atmosphere. And in this connection the Birmingham people are to be congratulated on having raised as much as £30,000 for the extension and improvement of the buildings, but we must still reiterate our contention that it would be better policy to expend the money on the acquisition of a more central site and the erection there of a normal exhibition building, rather than on adapting the Castle Bromwich aerodrome site to a purpose for which it was never intended.

Nevertheless, the organisers, the Birmingham Chamber of Commerce, have made admirable use of the material to hand, and, with the help of optimistic manufacturers, have evolved a Fair which savours, to us, something of Wembley and something of Olympia. That is to say, it is well repesentative of the industries of the Midlands and has a brightness which always seemed lacking in the arid halls of Wembley. Again, the Fair has the merit that mere sightseers are discouraged by an entrance fee and the journey out from Birmingham, so that the majority of the visitors may be taken as being seriously interested in the exhibits and intent on doing business. It may be that on the occasion of the visit of the Prince of Wales, on February 22nd, normal business was rather disorganised by a crowd of loyal people, but there is no doubt that the visit gave a lustre to, and attracted attention to, the Fair.

In returning to our description of the exhibits, we shall take them absolutely at random, much as we strolled about the Show; but will make this distinction, that electrical plant, being housed in a separate building, will be dealt with apart in the body of the current issue.

Between the "B" and the "C" buildings there is the new roofed-over space, to which we referred last week, and it seems only proper to deal with this neutral zone, between the mechanical and electrical exhibits, first. In it one of the most imposing stands is that of Joshua Buckton and Co., Ltd., of Well House Foundry, Leeds, and here one finds one of the few machine tools shown at the Fair. It is the planing machine illustrated by Fig. 1, which is of the high-speed type and admits work 10ft. long by 4ft. wide and 4ft. high, and is driven by a Lancashire patented reversing motor equipment.

The machine has two tool-boxes on the cross slide, which have self-acting feed motions for horizontal, vertical and angular cuts, and one tool-box on each upright, having self-acting feed motions and horizontal and angular traverse by hand. Hand wheels placed on diagonal shafts reaching downwards provide for the easy adjustment of the cross slide tool holders—when the slide is well overhead. The side tool-boxes are balanced, and all the tool-boxes have a double swivel motion. The cutting speeds range from 20ft. to 80ft. per minute, and the return speed is fixed at 160ft. per minute. The table is driven by a spiral gear, the main pinion of which runs in an oil well cast at the centre of the bed, while the driving wheel and its pinion run in an entirely enclosed gear-box.

Independent power feed and quick traverse motions are fitted, and these motions are driven by a separate 3 H.P. motor. By means of this gear the feed of any tool-box in any of its automatic motions can be varied over a wide range. All motions can be reversed and all feed motions instantly thrown out of gear without stopping the machine. The amount of feed is independent of the speed or amount of the table travel, and is always uniform at any given rate. It is effected at the end of the return stroke of the table and the broadest feed is completed within about 1in. travel of the table, or, say, one second of time. By the same gear, by simply pressing on a lever the cross slide tool-boxes can be quickly traversed independently or simultaneously in the same or opposite directions, the side tool-boxes can be traversed up or down on the uprights, and the cross slide can be raised or lowered upon the uprights. All these movements are controlled by means of a dial mechanism, which reproduces the table motion. Any length of stroke can be set and the speeds, feeds and rapid traverse motions can be controlled from one position, while the table is free from projecting tappets. There are also press buttons on either side of the machine with which it can be started and stopped.

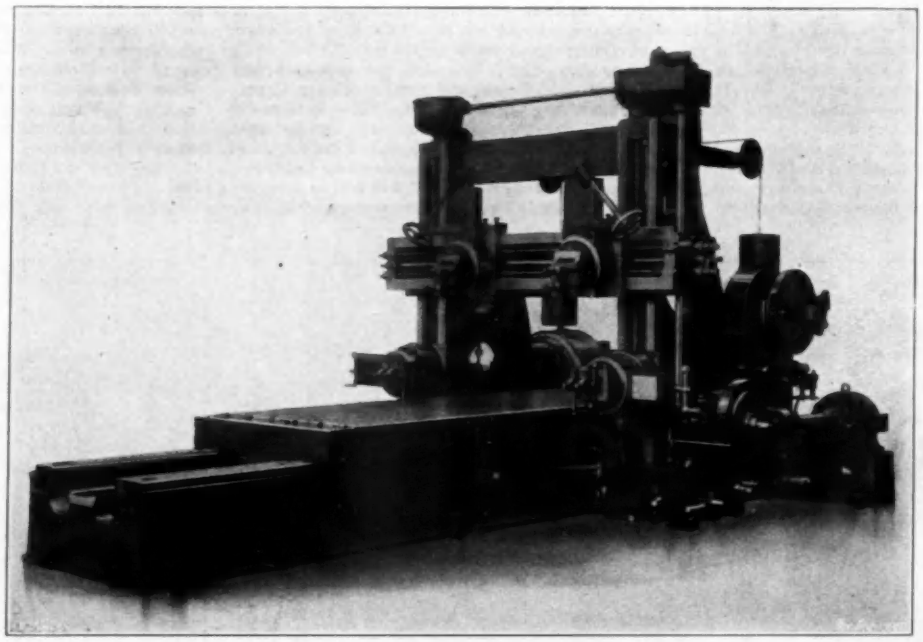


FIG. 1—10ft. HIGH-SPEED PLANING MACHINE—BUCKTON

One of the more novel features on this stand is the "Martin" balancing machine for accurately balancing rotary bodies, such as armatures, rotors, gear wheels, propellers, fans, impellers, fly-wheels, discs, crank shafts, &c., on the static principle. As will be seen from Fig. 2, one end of the piece being tested is supported by a freely suspended ball bearing on a rigid standard which can be adjusted along a bed-plate to suit its length, while the other end rests in a collar or bush supported by an adjustable vee slide, carried by a lever supported at one end upon a frictionless knife-edge and connected at the other end to a second lever or steelyard. This second lever carries a large movable poise-weight, while it also has an extension carrying a much smaller poise-weight, which serves to measure and indicate on a scale the moment of unbalance, if any, present in the body.

The deadweight of the body is first balanced by means of the large poise and the pointer at the end of the steelyard is made to register with a zero mark. The body is then rotated through, say, one-eighth of a turn, which will displace its centre of gravity if it is unsymmetrical and upset the balance. A restoring moment is then applied by moving the small poise-weight to left or right of its zero along the scale. Further angular readings are then taken until the restoring moments are found after increasing to start decreasing, or conversely, indicating that the position of the unbalance moment present in body has been passed—or the position diametrically opposite. This point can then be accurately located by taking one or two intermediate readings and plotting the readings on a chart from which the unbalance moment present in the body, in magnitude as well as its correct angular location, can be readily obtained. These machines are made in a variety of sizes to accommodate bodies of 10 lb. up to 120 tons, and each machine has a wide range; for example, a 15-ton machine will balance any body from one-third ton upwards, and detect and accurately locate unbalance moments of one-half inch-pound over its entire range. Similarly, a 10-cwt. machine will balance bodies from about 28 lb. upwards, and will detect and locate one dram-inch unbalance moment. Such an unbalance corresponds to a deviation of the centre of gravity in a 10-ton rotor of less than one-forty-thousandth of an inch. The actual machine exhibited at Birmingham has a capacity suitable for balancing bodies up to 3 tons in weight, and admits a maximum length between supports of 6ft. and a maximum diameter of 5ft.

Another new machine on this stand is the Buckton multilever testing machine, shown in Fig. 4, which is of 30,000 lb. capacity, and is capable of testing in tension or compression any description of materials from nickel chrome steel to timber, but is specially applicable to the latter purpose. Apparatus for testing specimens in deflection can be fitted when required.

The machine has an upper straining head connected by three struts with a weighing platform. The lower straining head is similarly connected by three screws with the gearing by which the load is applied. The three-screw and three-strut arrangement ensures perfect parallel movement of the straining heads and constant alignment of the specimen, so that there must be a direct pull. The upper and lower straining heads have open slides for the ready insertion of tension test pieces, and the wedge grips are operated by means of the hand wheels shown, thus avoiding any manipulation by hand of loose gripping pieces.

Compression tests are carried out between the lower straining head and the weighing platform, which has a finished flat surface to accommodate any form of die or deflection supports. The upper and lower straining heads and the weighing platform are of steel.

The straining screws are of good diameter, and work in gun-metal nuts which are driven simultaneously by cut gears, the drive being transmitted from a 2½ H.P. horizontal electric motor to the vertical direction by means of spiral bevels enclosed in the body. The gear-box contains four speed change gears, giving three rates of testing and a quick speed for adjustment. These gears are of steel machine-cut and run in a totally enclosed oil bath gear-box. The changes are effected by lever-operated sliding gears, much in the same fashion as in machine tool practice. When a great variety of speeds is required, a variable-speed motor may, of course, be employed.

The weighing apparatus is of the weighbridge type, and has a set of compound levers which communicate the load to a steelyard. The steelyard in this size of machine carries a 10 lb. poise weight and is gradu-

ated in thousands of pounds. The poise weight is traversed along the steelyard by a quick pitch beam screw actuated by a hand wheel through a universal joint and wheel and pinion at the end of the beam. There is also provided a graduated disc attached to the gear wheel on the end of the screw, which gives readings from 0 lb. to 1000 lb. by 5 lb. increments. Small adjustable weights running on a screw are provided for re-balancing the beam when the weight of the testing apparatus in use is varied by changing the compression apparatus, &c. The jockey weight is connected with the beam screw by a lifting nut and hand lever, so that it can be disengaged and slid back to zero or to any desired point. The jockey weight runs on three rollers, to reduce friction.

The 30-ton vertical single-lever testing machine, shown in Fig. 3, is of more familiar design, but is noteworthy on account of the means adopted to connect the straining motor with the screw gear. It will impose and accurately measure loads up to 30 tons and is arranged for testing specimens in tension, compression, deflection and torsion. Specimens can be admitted for testing in tension up to a maximum of 20in. between the grip boxes; in compression up to 20in. between platens; for deflection up to 60in. long between supports; and for torsion up to 8in. in length for observation and up to 1in. diameter.

The poise-weight for measuring the load is traversed along the lever by hand, although in certain cases power traverse by means of a separate motor is provided. The scale and vernier are graduated to read in tons, tenths and hundredths of tons. The traversing motion to the poise weight is transmitted through a universal joint, so that the weight is moved without disturbance of the equilibrium of the lever, which is quite free to oscillate in a vertical plane to an extent limited by the buffer stops. The machine is fitted with the Buckton Wicksteed patented bridle which prevents any damage that might be caused when a test piece breaks and consequently greatly increases the life of the knife edges. The knife edges are of specially treated hard steel of square section, ground absolutely true.

The straining head is moved by a hydraulic cylinder, the ram being operated by oil under pressure, supplied by means of a Hele-Shaw variable capacity pump, which is driven by a 2¼ H.P. motor. The Hele-Shaw pump permits of rapid and easy changes of speed being made in either direction by the operation of a hand wheel, so that testing can be carried out at any speed from zero to 6in. per minute. The setting of the straining cross head into position can be carried out at speeds up to 10in. per minute in either an up or a down direction. Lever-operated grip boxes are fitted, the grips being set or released by the movement of a single lever on each grip box. A full equipment of wedge grips is provided for flat and round specimens, and also a set of special quick-acting grips for specimens having solid heads. The compression and deflection apparatus is fitted with non-indenting swivelling supports and an articulated pressure foot.

The torsion apparatus will impose any load up to 16,000 lb. at 1in. radius. It is fitted with a telescopic socket for varying lengths of specimens and is driven by a worm and worm wheel, so geared that each revolution of the hand wheel represents a definite angle of twist.

In association with Messrs. Bostock and Bramley, the same firm is manufacturing a form of worm gear which provides a maximum area of contact between the rubbing faces, and several examples of this gear, including one which gives a reduction of 50 to 1, are exhibited on the stand.

Another interesting exhibit in the same part of the exhibition is that of Gibbons Brothers, Ltd., Dudley, which includes a furnace for the bright annealing of non-ferrous metals. It comprises a gas-fired furnace through which there runs a continuously moving chain platform. At both ends of the furnace the chain dips down into a water seal, which prevents the ingress of air into the annealing chamber, and so checks the oxidation of the articles being treated. A quaint air is given to this stand by the fact that the office is built entirely of fire-bricks, and its workmanship is a credit to the firm's bricklayers. Close by N. Hingley and Sons, Ltd., of Netherton Ironworks, have a number of specimens, showing the ductility of their pure wrought iron; while Heenan and Froude, Ltd., Worcester, are showing dynamometers of both the electrical and air resistance type.

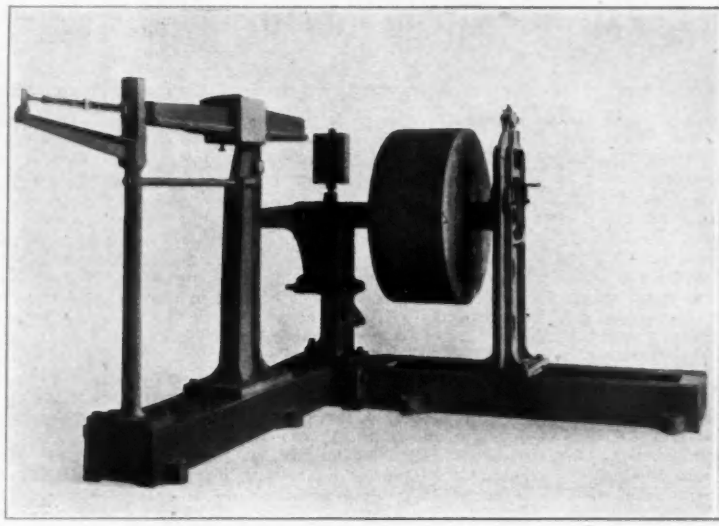


FIG. 2—MARTIN BALANCING MACHINE—BUCKTON

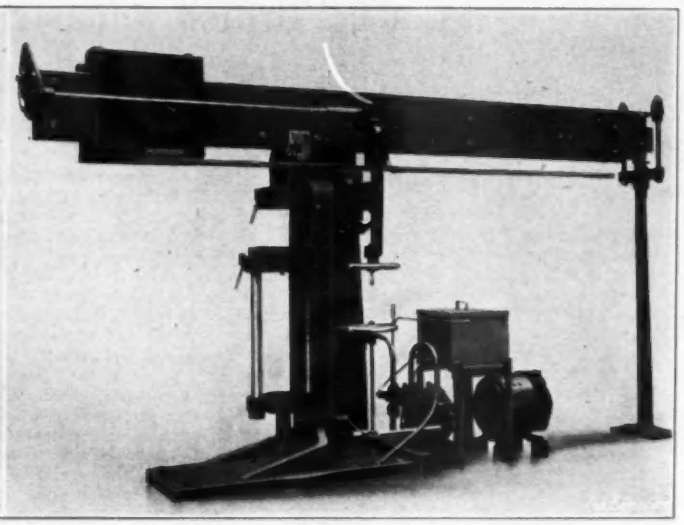


FIG. 3—30 TON TESTING MACHINE—BUCKTON

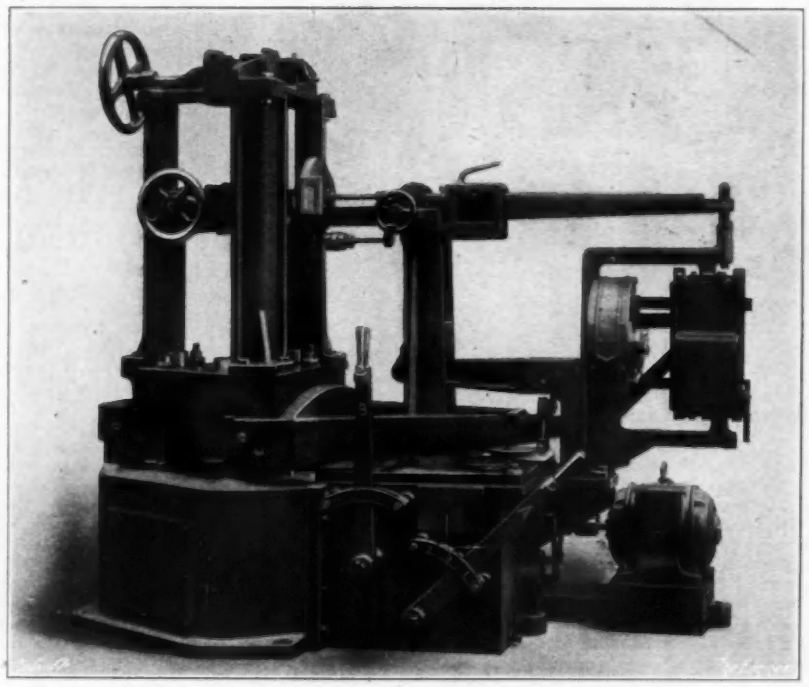


FIG. 4—30,000 LB. MULTI-LEVER TESTING MACHINE—BUCKTON

Marshall, Sons and Co., of Gainsborough, show a couple of oil engines, one a 16 H.P. horizontal type, and the other a 60 H.P. vertical, with which our readers are quite familiar. There is, however, a detail to which we have not previously devoted much attention. It is the governor gear, illustrated by Fig. 5, which operates by altering the length of the stroke of the fuel pump, and at the same time the point of the stroke at which the fuel is injected into the cylinder. In the drawing the pump and governor arrangement of the 60 B.H.P. vertical oil engine, just mentioned as being exhibited, are illustrated.

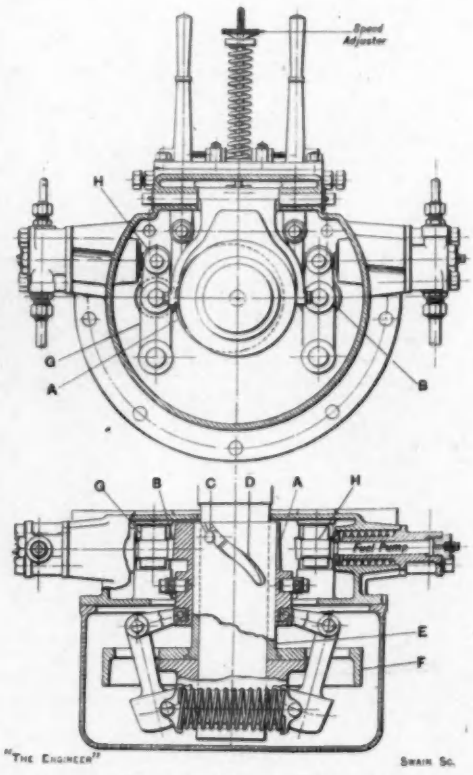


FIG. 5—OIL-ENGINE GOVERNOR GEAR—MARSHALL

The fuel pumps are operated by means of a taper cam A and a roller B. This cam is carried round by a special shaped pin C, one end of which is fitted in the spiral groove D in the sleeve E, attached to the governor carrier F. The other end of the pin projects into the cam, which slides along the sleeve under the control of the governor. When the load on the engine is reduced, the governor weights fly outwards, pulling the cam along the sleeve, thus bringing the smaller diameter of the cam into operation to drive the roller B which transmits the move-

ment through the lever G and roller H, thereby decreasing the stroke of the pump. At the same time the position of the cam is altered in relation to the crank pin on account of the spiral shape of the groove. In this way an earlier injection is effected with lighter loads, which, of course, gives better running.

G. and J. Weir, Ltd., of Cathcart, Glasgow, are represented by an elaborate display of Monel metal and malleable nickel in the form of hot-rolled and bright drawn rods, sheets, tubes, turbine blades, woven wire, and so forth; but the qualities of the metal are now so well appreciated that no further reference to the exhibit is necessary here.

Now, going back to Building "B" where the majority of the mechanical engineering exhibits are staged, one of the most fascinating machines is on the stand of Holden and Hunt, Cox's-lane Works, Old Hill. It is for the automatic production of plain chains, and is shown at work. It is illustrated by Fig. 6, and is working in conjunction with the welding machine shown in Fig. 7. A complete equipment for chain-making also includes a "fin-stripping" and a "calibrating" machine; but although these two are not on view at the Fair, we have included illustrations of them in Figs. 8 and 9, so as to make the series complete, and the various operations comprehendable, although it is, of course, impossible to give a really adequate description of each machine in the space here available.

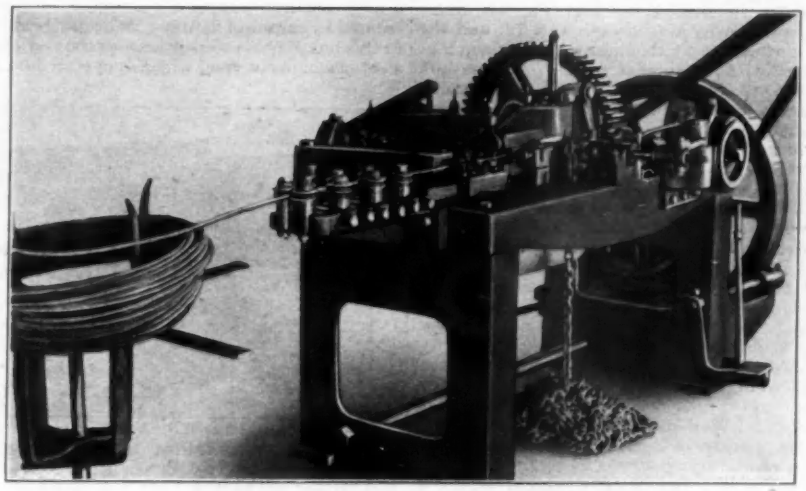


FIG. 6—CHAIN-BENDING MACHINE—HOLDEN AND HUNT

The process involves four distinct operations. The wire stock is first bent to form the interlaced links, with butted joints. The joints are then welded electrically, the fins or flashes produced by the welding are trimmed off, and finally the chain is given a slight stretch to determine its soundness and to define the pitch of the links. The chain is sometimes passed through a tumbling barrel to brighten it up. On account of the fact that there is a definite limit to the speed at which the welding machine can be worked without risk of burning the metal, it is usual to install three welding machines to serve one bender.

In the bending machine the wire, which may range in size up to ½in. in diameter, is supplied in coils and is drawn off a swift, through a set of straightening rolls, by a reciprocating feed action. This mechanism has a very positive grip on the wire, and is relied on to feed forward a precise length at each stroke. As the wire is fed forward, it is threaded through the previously formed link, which is held by a pair of spring fingers, mentioned later. At this moment a vertical forming mandrel is pressed down in front of the wire, from above, and a horizontal slide moves forward towards the wire from behind. The wire is cut off from the stock, and the two ends protruding on either side of the mandrel are pushed forward by prongs on the horizontal slide. The link is then in the form of a U, gripped between the slide and the mandrel. Two fingers in the front of the machine then close in and nip the ends of the U together to form an O. Immediately the link is formed the spring fingers mentioned above come forward and grip it, so as to take the weight while the mandrel and slide retire. The fingers then make a quarter turn, so as to present the link in such a plane as to allow the next link to be threaded through it. The sequence of operations is then repeated, but this time the fingers turn in the opposite direction. The reason for this is that if the turn were always in the same direction, the joints would form a continuous spiral round the chain, whereas by the reversing process the joints come down two sides only, which facilitates the subsequent welding process. The bender, by the way, produces from thirty to fifty links per minute, according to the weight of the chain.

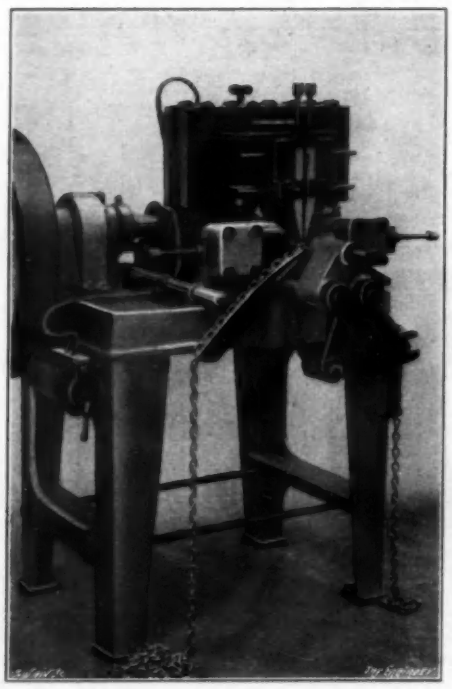


FIG. 7—CHAIN WELDING MACHINE—HOLDEN AND HUNT

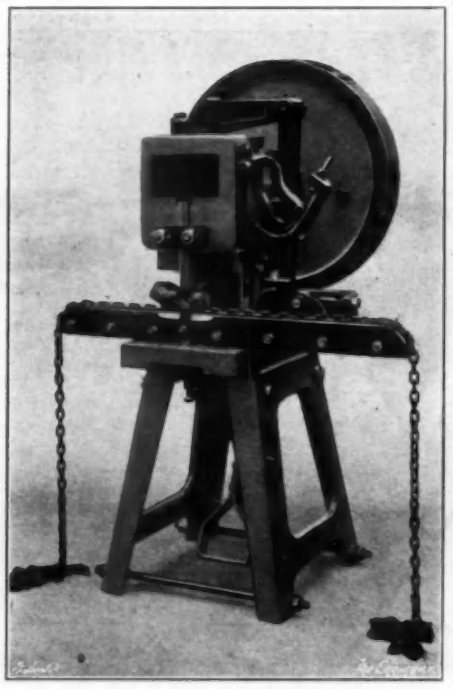


FIG. 8—FIN STRIPPER—HOLDEN AND HUNT

The welding is effected on the resistance principle, that is to say, a heavy electric current is passed across the joint and heats up the metal to welding temperature. The current is provided by a transformer mounted on trunnions at the top of the machine, with the ends of the secondary winding brought out in the form of two fingers, which press on the link on either side of the joint. The chain runs along in a groove in the machine table with the joints of one set of alternate links exposed upwards. The operator, generally a girl, pulls a clutch lever, which brings the fingers down to complete the circuit, and holds it in until she judges that the heat of the joint is proper. She then moves the lever again to bring into action two swaging dies, which hammer the weld together. The chain is then fed forward two links, and the next link but one is welded. When the whole length has been passed through the machine, it is returned, and the intervening unwelded links are completed.

As the chain leaves the welding machine, it has fins of metal, pressed out by the swaging operation at each of the joints, and these must be removed. The machine employed is a comparatively simple affair, much in the nature of a punch. The chain is fed across a groove, as in the case of the welder, and each alternate link is trimmed up by a bifurcated punch, which cuts off the fin on both sides of the wire simultaneously. Two passages through the machine are, of course, necessary.

FIG. 9—TESTING MACHINE—HOLDEN AND HUNT

The testing and calibrating machine is necessary, not only to ensure that there are no faulty links in the chain, but also to fix definitely their pitch, so that the chain will run comfortably over pulley block wheels. The machine comprises essentially two chain grips, one of which is fixed to the frame, while the other is slidable horizontally and is operated by a cam. A short length of the chain is fixed between the grips and is stretched out to a predetermined length by the action of the cam. The grips are then released and the operation repeated on the next length. Except for lifting the chain in and out of the grips, the action of the machine is automatic.

In conversation with Messrs. Holden and Hunt's representative, we learned that a typical works employing such a plant as that just described, but with an extra welder for odd sizes of chain, was capable of turning out over a ton and a-half of mixed No. 2 thirteen-link and No. 4 sixteen-link chain in a week of fifty-two hours. The hands employed were a tool fitter in charge, a youth on the bender, four girls welding and one girl each on the stripping and testing machines. The total production cost was, he said, less than 12s. per cwt.

Norris, Henty and Gardners, Ltd., of Patricroft, near Manchester, are exhibiting a 70 horse-power cold-starting heavy oil engine, and a new model, which is really the larger engine scaled down in size so as to develop 7 horse-power; but the most interesting item on this stand is a four-cylinder vertical of 96 horse-power (continuous rating). It is one of four supplied to a Yorkshire mill, and is noteworthy on account of the fact that the purchasers chose it in preference to an electric motor, on account of economy. The service which it has to perform entails running continuously throughout the week and the drive is transmitted by means of ropes. For these reasons electric motors were originally favoured, on account of the facility with which the motors could be moved to take up any slack in the ropes, but the oil engine has been made equally mobile. At the Fair the engine alone without its connections is shown, but in the mill it is mounted on a set of slide rails, with jacks arranged to traverse it and adjust the tension in the driving ropes. The exhaust pipe connection is telescopic, and the other pipes, such as those for fuel and circulating water, have double articulated joints. If it is found necessary to move the engine, these joints are slacked off slightly, and, with the engine still running, it is pushed sideways by means of the

jacks so much as is necessary. The joints are then tightened up again, the holding-down bolts screwed up and normal running resumed.

A simple but very effective machine for bending sheet metal, by Heywood and Porteus, Ltd., of Gomershall, near Leeds, is illustrated by Fig. 10. In it the sheet is bent upwards against the front edge of an angular shaped bar, which can be seen plainly running across the width of the machine, by the rotation of an anvil bar pivoted in trunnions at either end. At the same time another bar rises to grip the sheet tightly under the triangular bar. The bending anvil is turned by the two hand levers, which depend inside the frame, and is balanced by the upstanding counterweights shown. Its front edge is

FIG. 10—ANGLE BENDER—HEYWOOD

adjustable as to height, so that the radius of the bend round the corner of the triangle can be varied, while stops are provided to determine the angle of the bend. The gripping bar is raised by cam-like extensions of the anvil trunnions, which raise the gripper during the first part of the stroke, and then hold it securely. Beneath the triangle bar there is a series of stops, against which the sheet to be bent is pressed, and these stops are adjustable to determine the width of the flanges made. We tried several experiments with this machine, and found it very handy in making various types of bends, while it would turn No. 14 steel plate, 36in. wide, readily. In the case of light terne plate, it will make a close fold in two operations.

Messrs. Wadkin and Co., of Leicester, have a variety of woodworking machines on show, several of which are actually working. Among them there is a new cross-cutting and trenching saw, which seemed to us to be very handy in its application to straight work. At the top of a vertical column there is mounted a horizontal slide, which can be turned in a horizontal plane about the axis of the column. On this slide there runs a carriage, mounted on ball bearings, at the front end of which there is fixed an electric motor of 3½ horse-power. On the motor spindle there is mounted a saw, or any other rotary cutter, which it is desired to use. The motor and saw spindle can be set at any angle to the horizontal, and definite stops are provided to establish the more important angles, such as 30 deg., 45 deg., 60 deg., and so forth. In front of the machine there is erected a bench or table for supporting the work piece. The feed is effected by pulling the sliding carriage forward by hand and must, obviously, be in a straight line, but once that direction is set it can be repeated accurately as often as is desired, and automatic stops on the table provide for its repetition at definite intervals. The whole head can be raised or lowered with reference to the work table to adjust the depth of the cut. The machine is, of course, a development of the idea of the swing saw, but has the merit that it cuts straight instead of through an arc, so that it is specially applicable to such work as housing in making shelves and similar operations.

On this stand there are also shown the disc and bobbin sander illustrated by Fig. 11, the single dimension sawing machine shown in Fig. 12, and the combined surfacing and thicknessing machine, Fig. 13, together with a circular sawing machine and several other woodworking appliances. Concerning the machines which we illustrate it is not necessary to make many comments, as their construction is fairly obvious from the engravings; but it is noteworthy that in the case of the dimension sawing machine exhibited the motor is connected directly on the saw spindle, so that all power transmission losses are avoided. It is, in fact, the general policy of Messrs. Wadkin to eliminate belting in the woodworking shop as far as is possible. Another characteristic of their machines is the adoption of gearboxes, after the fashion of those used on engineer's machine tools, in the place of belts and cone pulleys, for varying the rates of feed.

Among the firms which are showing special steel sections, there may be mentioned James Mills, Ltd., of Bredbury, near Stockport, and Stringer and Co., of Wincobank Steel Works, Sheffield. The former firm is principally interested in soft steels, which are displayed in a great variety of special sections, while a new free-cutting steel has recently been brought out to compete with American material of this type. A nut-making machine, in operation on the stand, is used to demonstrate the free-cutting qualities of the steel, which appear to be excellent, while its price is said to be less than that of imported metal. Messrs. Stringer are more concerned with tool steels and those for case-hardening, and have a wide range of carbon, tungsten and nickel steels. Another firm of steel makers is Jno. Hy. Andrew and Co., Ltd., of Sheffield, which, besides all kinds of steel, exhibits a number of tools, such as files, drills, &c., and some whortle plates for wire drawing.

The Soldo Company, of Sicilian House, Southampton-row, London, W.C. 1, has a stand on which the qualities of its tinning compound—already described in The Engineer—are demonstrated, and it may be of interest, in view of our previous experience of its ability to produce a satisfactory tinned surface on metals generally considered difficult to tin, to say that we tried it again on the stand in several different ways. Staybright steel, nichrome and an old piece of corrugated roofing iron, which was very much corroded were readily tinned, while pieces of Stellite and high-tension nickel chrome steel were properly tinned with the assistance of a little persuasion from a soldering iron.

William Cooke and Co., Ltd., of Tinsley, Sheffield, have a representative display of wire rods, such as those which we described in connection with our series of articles on wire-drawing, and a variety of other rolled sections, besides a new type of stainless steel in several different forms; but the most novel exhibit is a set of "road studs." These studs are mushroom-like castings of the same stainless steel, which are intended for planting in the road surface at crossings and other points where it is desired to give instructions to passing traffic. They have a slightly rounded top face, which just protrudes above the road surface and is kept polished by the traffic, so that they are easily visible by day and night and are, naturally, much more permanent than painted lines or signs.

Hollings and Guest, Ltd., of Thimble Mill-lane, Birmingham, have several hydraulic presses and pumps, which we have described in connection with previous exhibitions; but there is a novelty on this stand in the form of a little hand-operated press for bundling light scrap, such as tin cans. It comprises a long cast iron box with a hinged lid which can be secured by means of fly nuts. Working longitudinally in this box there is a head fixed on the end of a forged steel machine-cut ram, which is operated by a pinion

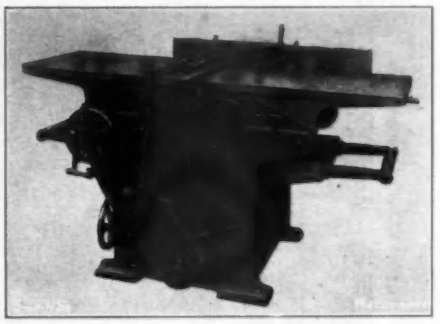
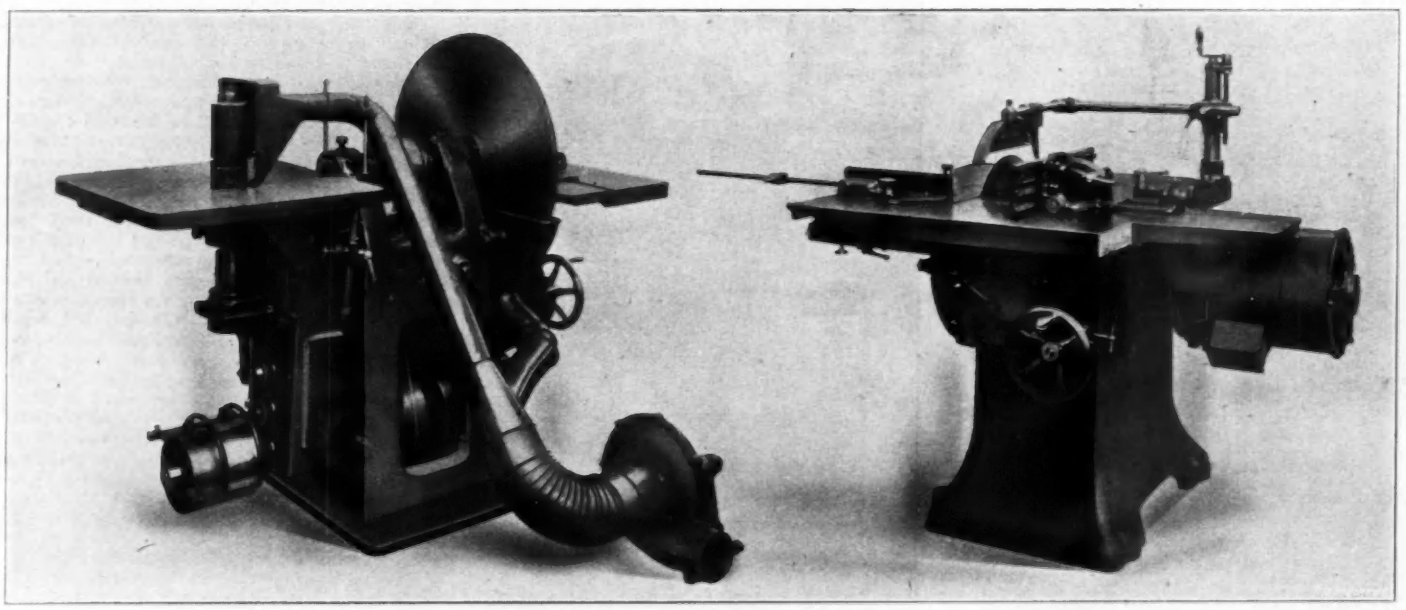


FIG. 13—THICKNESSING MACHINE—WADKIN

and ratchet gear. The ratchet can be applied either to the fast or the slow-speed shaft of the driving gear, so that the loose scrap may be quickly squeezed together and then compressed tightly. There is a hinged door at the end of the box for the ejection of the bale.

A rather attractive display is that of L. Nicklin, Ltd., of Soho, Smethwick. It comprises a variety of ladders made of steel tube welded together by means of the acteylene blow pipe. The joints are all butted and filled in with welding metal, so that they are probably stronger than the tube itself, and the ends of the side members are closed to exclude moisture. Both plain and girder-fashion sides are made. These ladders are remarkably light—some 25 to 35 per cent. lighter than wood ladders of similar strength—and we found them very rigid and convenient to handle.



FIGS. 11 AND 12—COMBINED DISC AND BOBBIN SANDER, AND SINGLE DIMENSION SAW BENCH—WADKIN

The New Conveyor Company, Ltd., of Smethwick, Birmingham, is showing a new form of conveyor for general purposes, such as handling unit parts of motor cars in the assembling shops. It comprises a simple flat link chain, running over sprockets, to which there are attached stout wooden slats to carry the load. Rollers running on angle irons are provided on either side to carry the weight. These conveyors are generally made up with just a few slats at regular intervals, according to the requisite spacing of the loads. This firm is also exhibiting a new form of guide roller for belt conveyors, which runs on ball bearings. The bearings are encased inside the boss of the roller, which also provides a receptacle for lubricating grease. The spindle, of course, does not rotate and is merely dropped into recesses in the

bracket, so that it is a very simple matter to remove any roller if it requires attention.

In referring to the Blackstone oil engines at the Fair last week we mentioned the fact that one of the vertical sets was equipped with a new form of exhaust valve gear, and we are now able to give a line drawing of the essential parts of this mechanism, the charm of which is that it is operated by an excentric. By this means the heavier parts of the gear are given a true harmonic motion, while it is only in the immediate vicinity of the valve that there is any intermittent movement and the engine runs correspondingly smoothly.

On reference to Fig. 14 it will be seen that the exhaust valve stem is screwed into a guide plunger D and is secured by a lock-nut G. It slides through a bush F and is saved from exposure to dirt and wear by the sleeve H. The guide plunger is slotted vertically and has a transverse pin C on which the roller B

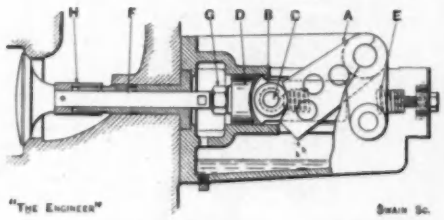


FIG. 14—EXHAUST VALVE GEAR—BLACKSTONE

rides. This roller occupies the front end of the slot in the plunger, while the ends of the pin protrude sideways for the attachment of two springs, one of which is shown at E. Within the slot in the plunger there works a cam plate A, fixed on a transverse shaft, as shown. This shaft is given an oscillating movement by means of an excentric, as already mentioned. It will be noticed that the cam has a rather peculiar formation and this shape has the effect of lifting and seating the valve very gently, while it is moved very rapidly as soon as it is off its seating. At every stroke the heel of the cam dips into an oil bath and picks up one or two drops of oil, which lubricate the various running parts, but an appropriate drain hole prevents the possibility of any lubricating oil finding its way along the valve stem guide into the cylinder.

A new automatic screwing machine exhibited by Thomas Chatwin, Ltd., of Great Tindal-street, Birmingham, is illustrated by the half-tone engraving Fig. 15. It is intended for screwing fairly large stock—say, bolts up to 2in. in diameter and up to 3in. pipe. It has a stop action which automatically opens the dies when the requisite length of thread has been cut. This opening movement is ample to clear the tops of

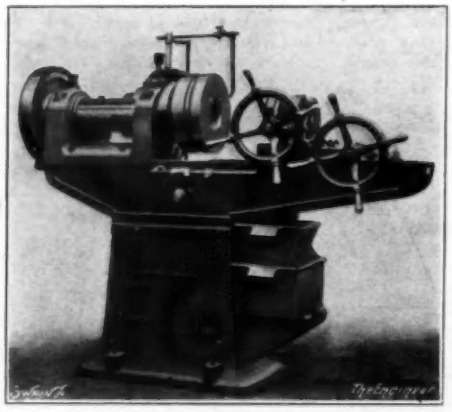


FIG. 15—SCREWING MACHINE—CHATWIN

the deepest thread likely to be cut on the machine. The dies remain open until the saddle is drawn back to its original starting position, and at this point a second automatic action takes place and re-sets the dies for screwing the next piece. The machine struck us as being well constructed and is sufficiently powerful to cut threads up to the dimensions mentioned at one pass.

Lee, Howl and Co., Ltd., of Tipton, Staffs., are showing a variety of pumping plant, including a new design of double-inlet centrifugal pump intended for such purposes as drainage and irrigation, a multi-stage turbine pump, and several reciprocating pumps. A new departure for this firm is the production of refrigerating machinery on the ammonia compression principle, but as the inventor, who was in charge of that part of the exhibit, was unwilling to impart any technical information concerning its construction, we are unable to pass any opinion on its merits.

On the stand of Petters, Ltd., which firm, by the way, now has full control of the works at Ipswich besides those at Yeovil, there is the usual collection of oil engines, which include sets of 70 and 12 horse-power in the stationary form and a 24 horse-power twin-cylinder marine engine. There is also on this stand a fuel pump unit and spraying jet, rigged up on a stand, with the jet hooded over, so that the atomising effect of the jet can be demonstrated—and it certainly does show a very nice jet.

There are two new machines on the stand of Taylor and Challen, Ltd., Derwent Works, Birmingham, which are illustrated by Figs. 16 and 17. The first is intended for removing in one operation the ragged edges left when an article is stamped from sheet metal with upstanding edges. It is shown in operation working on the sheet metal covers for electric flat irons. The rough stamping is put on an appropriately shaped head on the end of a horizontal ram, and is pushed into a female holding die. While it is thus held four shearing blades advance from opposite

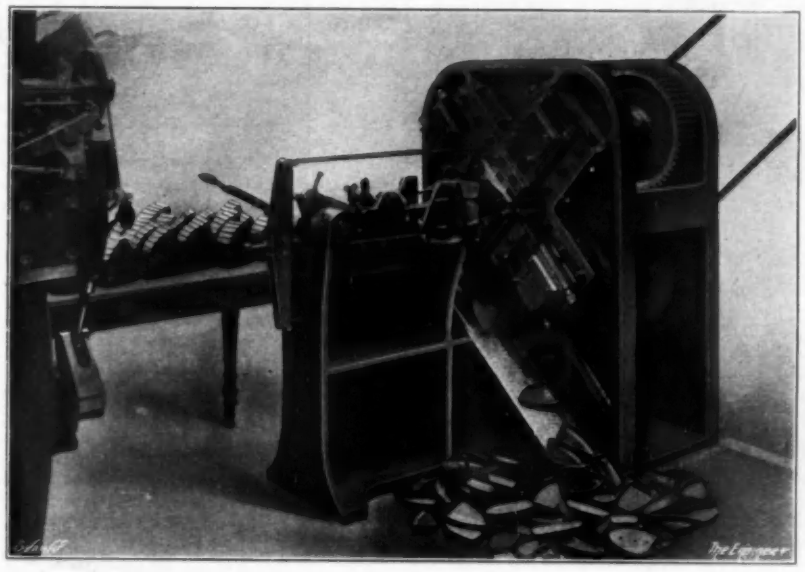


FIG. 16—FLAT-EDGE TRIMMING MACHINE—TAYLOR AND CHALLEN

corners of the square framing, and cut off the scrap against the sharp edge of the holding die. The four blades are fixed, as will be seen in Fig. 16, in separate slides, and each one is operated by a crank pin on a short shaft passing through the frame of the machine. The four shafts are geared with a common driving pinion by means of cut gears, and consequently work in unison, but not simultaneously, as if they did so the shearing cutters would foul one another at the end of the stroke. The cutters and holding dies have, of course, to be made to fit the article being cut, but as the slides have a stroke of 1in., a certain amount of latitude in their conformation to the outline of the article is allowable. The machine will accommodate

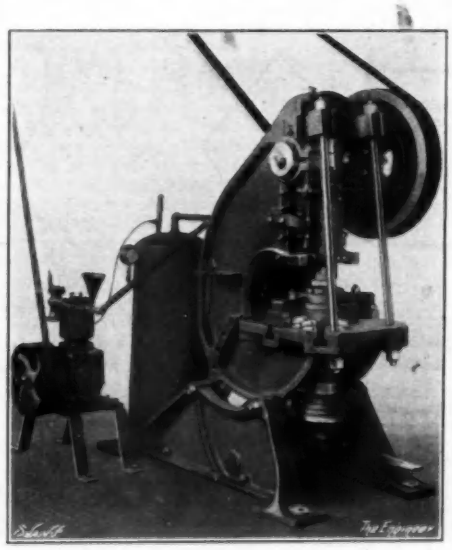


FIG. 17—PRESS WITH PNEUMATIC DIE CUSHION—TAYLOR

pieces up to 6in. square by 5in. deep and of No. 16 gauge, while the output is six pieces per minute.

The inclinable press illustrated by Fig. 17 is chiefly noteworthy on account of the fact that it is equipped with a pneumatic cylinder to cushion the pressure between the punch and pressure ring, which holds the blank during the operation of pressing, and in this way puckers at the edges are practically eliminated. The necessary pressure air is provided by a little compressor driven by belting from the main driving shaft of the press, and is stored in a receiver fitted with the usual fittings. The pressure in the air cushion can be varied from 5 lb. to 100 lb. per square inch, according to the work in hand. With the air cylinder removed, the press is suitable for ordinary blanking work.

T. Robinson and Son, Ltd., of Rochdale, show a collection of woodworking machines, among which there is the saw bench illustrated in Fig. 18. This machine is intended for accurate sawing to dimensions and angles, such as is required in patternmaking, and its outstanding feature is the provision of two saw spindles, so that ripping and cross-cutting saws can be used alternatively. The two spindles are mounted on opposite ends of a yoke, which is pivoted below the table so that either saw may be swung up above the table into the working position. The saw spindles, by the way, run in dust-proof ball bearings. The driving belt runs over jockey pulleys in such a fashion that the saw not in use does not run. The length of the yoke is such that two saws 16in. in diameter or one saw 20in. in diameter can be accommodated. In the former case the maximum projection of the saw above the table is 4¼in., while with the 20in. saw the projection is 6¼in. The table, which is 44in. long by 40in. wide, can be canted over to an angle of 45 deg. by means of a worm gear, and there is a graduated scale to show the precise angle at which it is set.

The front part of the table, which moves on small

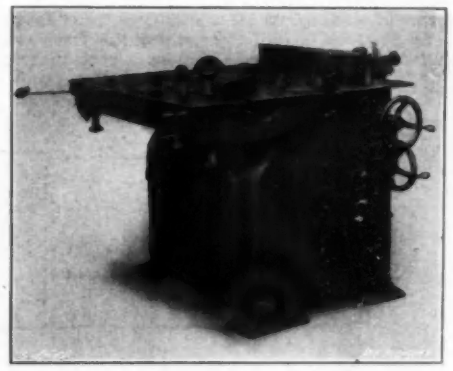


FIG. 18—TWO-SPINDLE DIMENSION SAW BENCH—ROBINSON

rollers, is 16in. wide and allows sufficient movement to cross-cut up to 36in. It can be locked in position by means of a spring stop. The width of the saw gap may be increased to allow a cutter block 2½in. wide to be used for moulding, tongueing, grooving, beading, &c., or a special saw may be used for grooving. The fence can be quickly moved from the saw to rip up to 21in. wide on the right-hand side, the width being shown on a graduated scale. A micrometer screw is fitted for fine adjustment. The fence can be canted to 45 deg., will swivel to an angle of 30 deg. either way, and can be used on either side of the saw to allow core boxes to be roughed out. A taper pin locates the fence parallel with the saw, and a single hand screw holds it firmly when canted. The mitreing and cross-cutting fence is pivoted on the sliding table across a scale graduated in degrees to facilitate quick setting. The principal angles are determined by a taper pin stop. A rod with a movable stop is fitted for cutting off up to 36in. long. A graduated universal mitreing and cutting-off gauge for small work is also provided, and can be used on either side of the saw. This gauge slides in ways planed in the table, and on its face there is a steel sliding piece, to form a support for the timber close up to the saw when the gauge is set at an angle. Provision is also made for a rod with sliding stops to be carried.

On the stand of the Rapid Magnetting Machine

Company, Ltd., Lombard-street, Birmingham, there are several machines for the magnetic separation of materials, several of which have already been described in our columns, together with some lifting magnets. The latter include the bi-polar magnet shown in Fig. 19, which in itself requires little comment, but the controller with which it is associated is rather noteworthy. These magnets are made of a special steel which has a high degree of magnetic retentivity, and, as a consequence, it is necessary to reverse the current in the energising coil to release the load freely. The steel also has the characteristic that when once it has been magnetised to saturation the flux can be

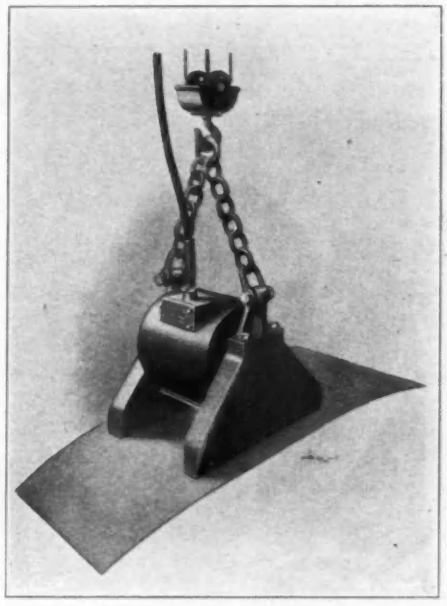


FIG. 19—LIFTING MAGNET—RAPID MAGNETTING

maintained by a current less than that necessary to initiate that flux. The controller is consequently so devised that on the last notch it puts a resistance in the magnet circuit and reduces the current slightly, with a corresponding economy. It also has a reverse notch for releasing the load.

In the Steam Power Section of the Fair the Crosthwaite Engineering and Furnace Company, Ltd., of York-street, Leeds, is showing one of its sprinkler type mechanical stokers, a section through which is illustrated by the line drawing Fig. 20. It is of the type in which the grate is divided transversely into a number of sections, which are independently moved in a longitudinal direction by cams at the front. The reciprocating action of the sections is such that the fire is gradually pushed back into the furnace and the clinkers are finally tipped over the end of the grate into the ashpit. The fire-bars are made hollow and butt together to form ducts into which a draught of air is forced by steam jets arranged across the front of the boiler. We were assured that the amount of steam used by these jets does not exceed 3 per cent. of the total steam raised by the boiler. The coal is sprinkled on to the fire from a hopper by means of a spring-operated shovel, which has an oscillating movement. This shovel is of V shape in front, so that it tends to distribute the coal well out on the sides of the grate and the arm which carries it is so shrouded that it cannot become jammed by an accidentally large lump of coal.

Belliss and Morcom, Ltd., of Ledsam-street, Birmingham, have a large stand in the Steam Power Section, on which there are exhibited a 750-kilowatt steam turbine coupled with an alternator by the Lancashire Dynamo Company, a 290 B.H.P. high-speed engine, which, by the way, is the forty-fourth of its type supplied to the Calico Printers' Association; a paraffin engine and the condensing set illustrated by Fig. 21. Perhaps the most interesting feature about this set is the little steam engine which drives the extraction pump, which has been specially designed to run continuously at the high speed of 1500 revolutions per minute and so eliminate the necessity for gearing in driving high-speed pumps. It is really of more or less normal design, but by cutting down the length of the stroke and by careful attention to details it has been found possible to make it run at this high speed for long periods without any sign of fatigue. It has all the fittings the makers are accustomed to apply to their larger engines, such as forced lubrication to all the bearings, including those of the governor, and drains from the top of the casing for leading down the oil and water which tends to collect there into a pocket in the bed-plate. In this pocket there is an oil and water separating device, which returns the oil to the crank case and rejects the water to waste. Both the piston and valve rods are fitted with metallic packings.

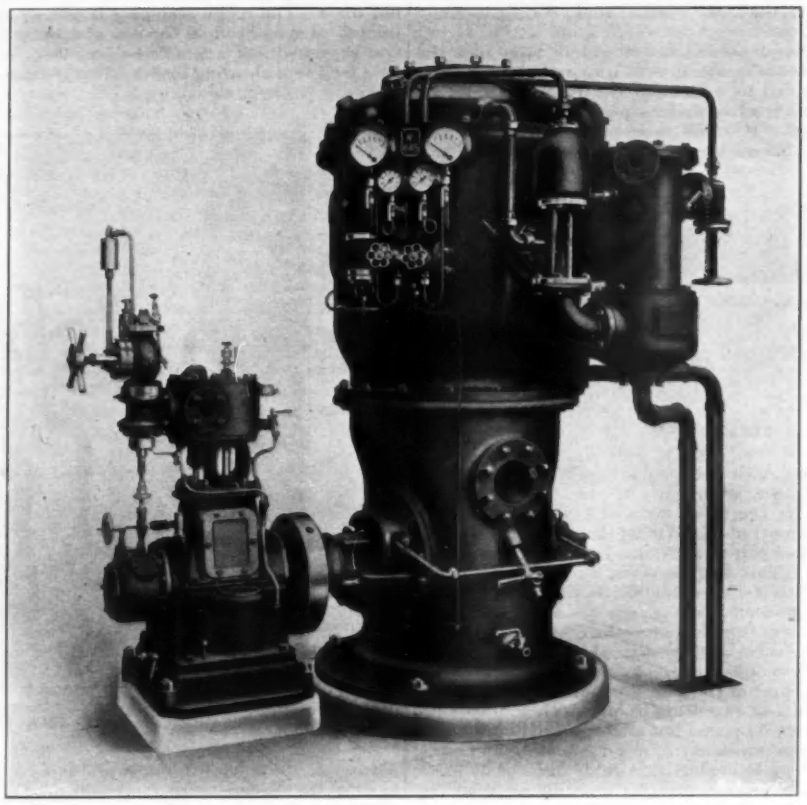


FIG. 21—MULTI-JET CONDENSING SET—BELLISS AND MORCOM

Musgrave and Co., Ltd., of Belfast, have, besides the induced draught fan in the Steam Power Section, a new piece of plant in the form of a dust-collecting unit. The idea is that a unit should be installed in connection with each machine requiring the removal of dust, instead of using a central dust-collecting plant, so that individual dusts which have a commercial value may be saved separately. The collecting unit is really a very simple affair, and comprises a centrifugal fan connected with the source of dust by means of trunking. It delivers into an overhead rectangular box of steel plate, from which depends a group of canvas tubes. These tubes are specially woven without seams and their number depends upon the volume of material to be handled. At the bottom the tubes are connected with a hopper which discharges into a sack. There is a system of levers by means of which the tubes can be shaken occasionally by hand to dislodge any dust adhering to the insides of the tubes. The air, of course, percolates through the canvas and is returned to the working room. In industries where special atmospheric conditions have to be maintained a saving is in this way effected, as compared with the usual systems of dust collection, as the air is merely circulated in the vicinity of the machine concerned. On the same stand there is a new and handy form of propeller fan for producing a local cooling draught. It is driven directly by an electric motor and is mounted on the top of a tall cast iron standard, round which it can swivel. This fan is made in three sizes ranging in diameter from 24in. to 36in.

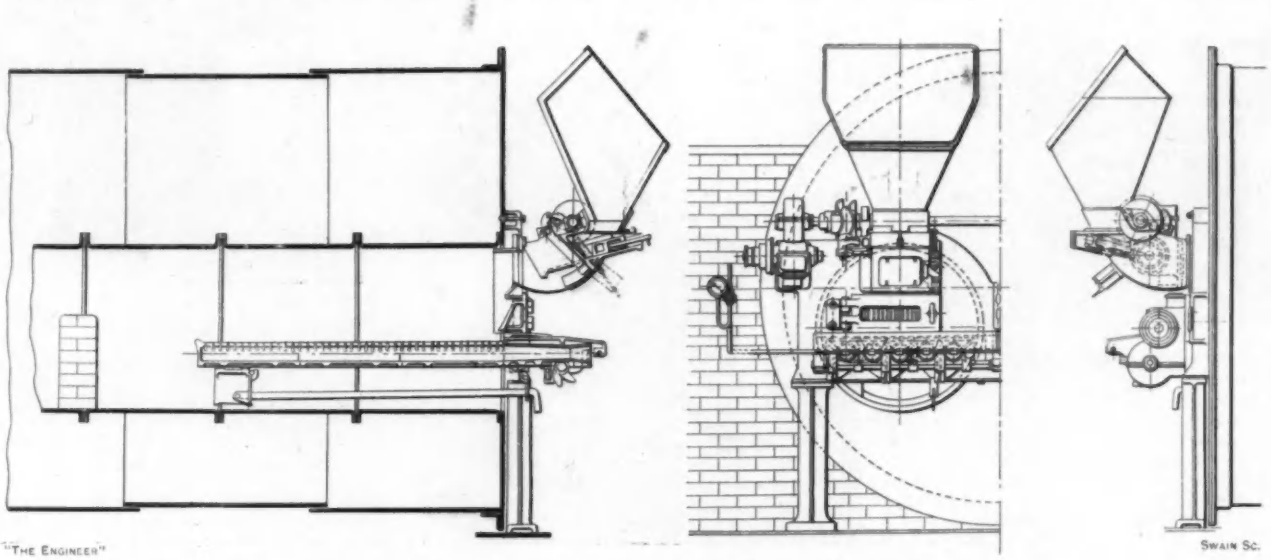


FIG. 20—SELF-CLEANING GRATE AND SPRINKLER STOKER—CROSTHWAITE

W. H. Allen Sons and Co., Ltd., of Bedford, have a large stand in the Steam Power Section, on which there are exhibited a 100-kilowatt two-crank compound engine, fitted with forced lubrication, direct coupled with a continuous-current dynamo, and a 250-kilowatt impulse type turbine driving a dynamo

through helical reduction gearing. There is also a 50 horse-power two-cylinder heavy oil engine and a centrifugal pump. All these machines are familiar to our readers and require little comment. The turbine runs at a speed of 6000 revolutions per minute, while the gearing reduces this speed to 650 revolutions per minute at the dynamo spindle. It takes steam at 210 lb. per square inch superheated to 590 deg. Fah. and exhausts against a back pressure of 20 lb. per square inch. The compound engine has cylinders 10in. and 16in. in diameter by 7½in. stroke and runs at 500 revolutions per minute. It is capable of running either with steam at from 125 lb. to 200 lb. per square inch and exhausting against a pressure of from 0 lb. to 5 lb., or with steam of from 105 lb. to 200 lb. pressure and exhausting into a condenser. The oil engine is of the vertical type and runs at

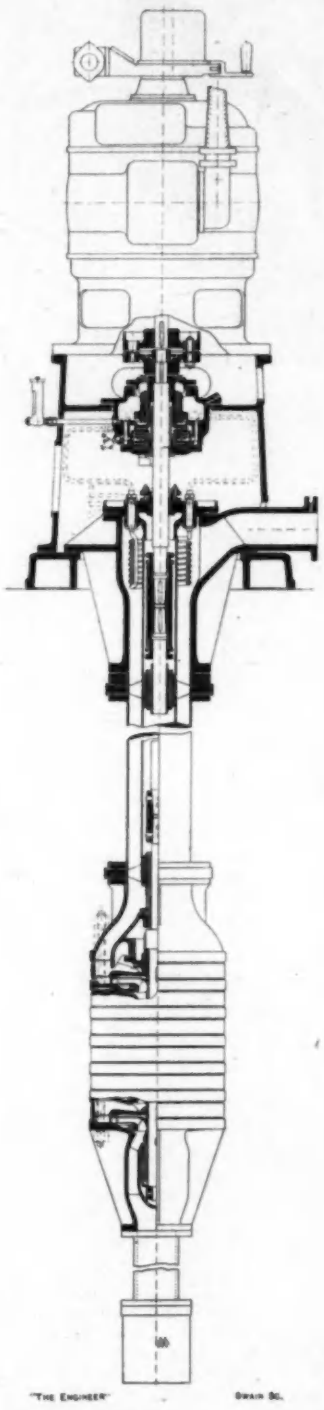


FIG. 22—BORE-HOLE PUMP—ALLEN

375 revolutions per minute. It is intended for working with any good quality of fuel oil, such as residual petroleum or shale oil of a specific gravity not exceeding 0·92. The centrifugal pump is of a type which has a considerable vogue in Egypt and Mesopotamia for irrigation purposes and is capable of an output varying from 250 to 800 gallons per minute against a head varying from 10ft. to 50ft. The speed ranges between 640 and 1140 revolutions per minute. There is also a model of a condenser having 35,000 square feet of cooling surface.

On the firm's adjacent stand there is a model of a bore-hole pump similar to that of which we give a line drawing in Fig. 22. These pumps are virtually the maker's multi-stage turbine pump stood on end and hung at the bottom of a rising main with a central driving shaft reaching up to a vertical motor at ground level. The rising main is of lap-welded steel tube and is usually made up in lengths of from 7ft. 6in. to 8ft. 6in. At each joint there is a spider for supporting a bearing for the driving shaft. In cases where the water is clean the bearings are bushed with lignum vitæ and the water itself is relied upon to provide lubrication. Where, however, the water is very gritty a second tube is arranged inside the rising main to protect the shaft, and separate lubrication is provided for bronze bearings. The shafting is, of course, turned all over and is of such a diameter as to avoid approach to its first critical speed, so that there is no liability for it to whip. The shaft couplings are of the muff type with conical seatings. Any unbalanced weight of the rotating parts is carried by a Michell thrust bearing.

For the purpose of keeping live the steam main round the power plant, which, by the way, was supplied by the Bromford Tube Company, Ltd., of Aston, Birmingham, Cochran and Co., Annan, Ltd., of Annan, Scotland, have at work a vertical tubular boiler, 4ft. 9in. in diameter by 11ft. 9in. high, fired by oil and fed by a Weir pump. We learned on this stand that the makers have recently brought out a modification of their standard type of boiler specially for steam navvies, drag lines, and similar machines. The difference lies in the fact that the smokestack goes up inside the boiler shell from the smoke-box, instead of being entirely outside the shell. The reason for this arrangement is that with the normal scheme the smokestack extends over the back of the machine and increases its turning radius. It is claimed, however, that the inside smokestack does not suffer greatly from the trouble experienced with simple vertical boilers, of wastage of the stack at about the water line, as with the Cochran boiler the heat of the furnace gases is largely dissipated by the water tubes before the gases get to the stack.

Two types of boiler, the water-tube and the Lancashire, both by John Thompson, Ltd., of Wolverhampton, are represented and are similar to those we recently described in connection with the Smoke Abatement Exhibition. The water-tube boiler is equipped with a Liptack furnace arch and is arranged for burning coal powdered by means of a Herbert Atritor pulveriser. Among the instruments connected with this boiler there are a draught gauge, a thermometer and a CO_2 indicator, by the Cambridge Instrument Company; a steam flow indicator, draught and pressure indicators, and a CO_2 recorder, by the Electroflo Meter Company, Ltd.; a boiler level indicator, by George Kent, Ltd.; and a Copes automatic feed water regulator, by James Gordon and Co. The economiser connected with the boiler is by the Clay Cross Company, Ltd.

In the case of the Lancashire boiler, only the front end ring of which is shown, one of the furnaces is fitted with a Crosthwaite grate, already described, fed by an automatic scale, by W. and T. Avery, for measuring the coal input. The feed water for this boiler is supplied by a turbine-driven pump made by the Rees Roturbo Manufacturing Company, Ltd., of Wolverhampton, and is measured by means of a recorder by the Lea Recorder Company, Ltd. We have already dealt with the water softening plant and most of the other important items comprising the Steam Power Section in connection with the individual firms' stands.

In connection with the model boiler-house plant in the Steam Power Section, Davidson and Co., Ltd., of Belfast, are showing one of the flue dust collectors, already described in THE ENGINEER, which remove from the flue gases, not only the particles of grit, but dust so fine that it will pass through a 200-mesh screen. On an adjacent stand the firm is showing a working model of this collector, as well as a representative selection of "Sirocco" fans. One of the fans is dismantled, affording an opportunity for the inspection of its construction. A small collector for dealing with industrial dust in a factory is also shown in operation.

On the stand of Frank Pearn and Co., Ltd., there is a new form of water lifter or "hydrohoist, as it has been named, which is illustrated by Fig. 23. The machine works on somewhat the same principle as the *chaine helice*, for it relies partly on an entraining action and surface tension to enable a flexible band to raise the water from, for instance, the bottom of a well. In the case of the hydrohoist, the flexible band takes the form of a wire rope, on to which there are threaded a great number of shallow little cups, as is shown in the left-hand view of Fig. 23. These cups are steel pressings, and are fixed on to central sleeves by a beading process, which makes the joint practically water-tight. The absolute tightness of this joint is not, however, of any great import, as the surface tension, or capilliary effect, is ample to retain any water in the cups. At intervals of 6ft. or so, along the length of the band, rubber buffers are inserted between the adjacent cups to keep the whole assembly taut. The band thus formed is slung over a driven pulley at the head of the well, and is guided at the bottom by a deeply grooved pulley, which hangs freely in its bight. This pulley must be immersed in the water to the extent of at least 3ft. at its centre, in order to ensure that the cups on the rope will be completely filled with water on the rising side of the band. In the head piece the band passes through two tubular guides, which extend upward to a height above the level of the outlet, so as to prevent the water raised being spilled down the well again. In some cases the alternate cups on the rope are of different diameters, and it has been found that such an arrangement does not materially affect the lifting capacity of the apparatus. Two standard sizes of cups have been adopted, one of 1⅜in. diameter and the other 2¼in., and their outputs are 560 gallons per hour and 1000 gallons per hour respectively when they are run at a linear speed of some 200ft. per minute. Machines of this type have been successfully operated on lifts of as much as 400ft.

A new form of direct-acting feed pump, which has been specially devised to minimise the overall height, is also shown on this stand. In it the steam and water cylinders are brought close together, with just sufficient clearance between for the convenient packing of the piston-rod glands, and the steam distributing valve is worked from the top in the following manner:—The piston-rod is hollow and within it there slides

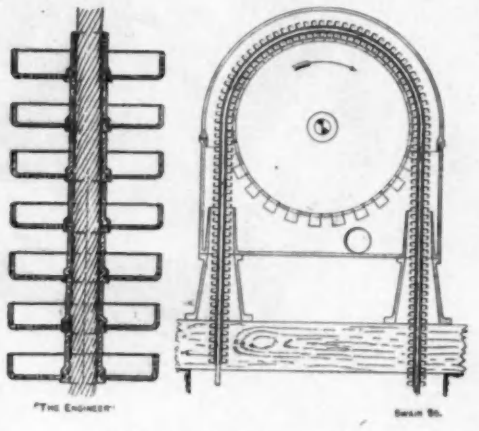


FIG. 23—WATER LIFTER—PEARN

a tappet rod hanging from the top cylinder cover. This rod has shoulders at either end, with which a nut on the piston-rod engages, and is used to operate a rocking lever pivoted on the top cover. The opposite end of this lever is connected with the spindle of an auxiliary slide valve for controlling the supply of steam to a piston which works the main slide valve. The main steam ports do not extend right to the end of the cylinder bore, so that the piston over-runs them and imprisons a little steam at the end of the stroke, which cushions the reversal. There is, however, a small auxiliary port which allows the steam to escape slowly and brings the reciprocating parts to rest gently, while the same port admits a little steam to start the next stroke. One of these pumps is at work in the model steam power plant, and although it must be admitted that it is working at a very moderate pressure, it certainly runs very smoothly.

Besides a variety of acetylene welding equipments, with which our readers are familiar, Allen-Liversidge, Ltd., of Victoria Station House, Westminster, are

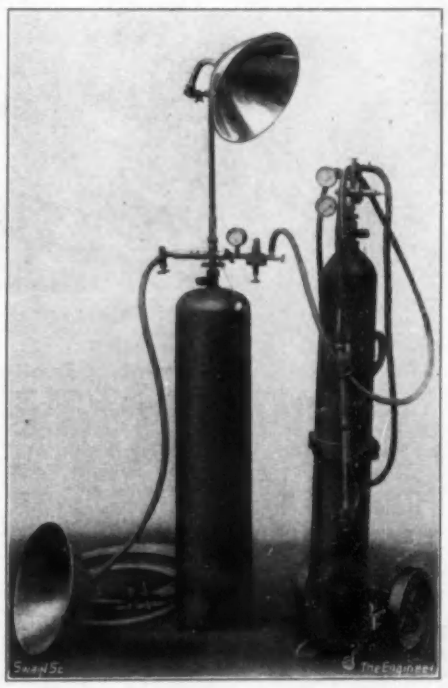
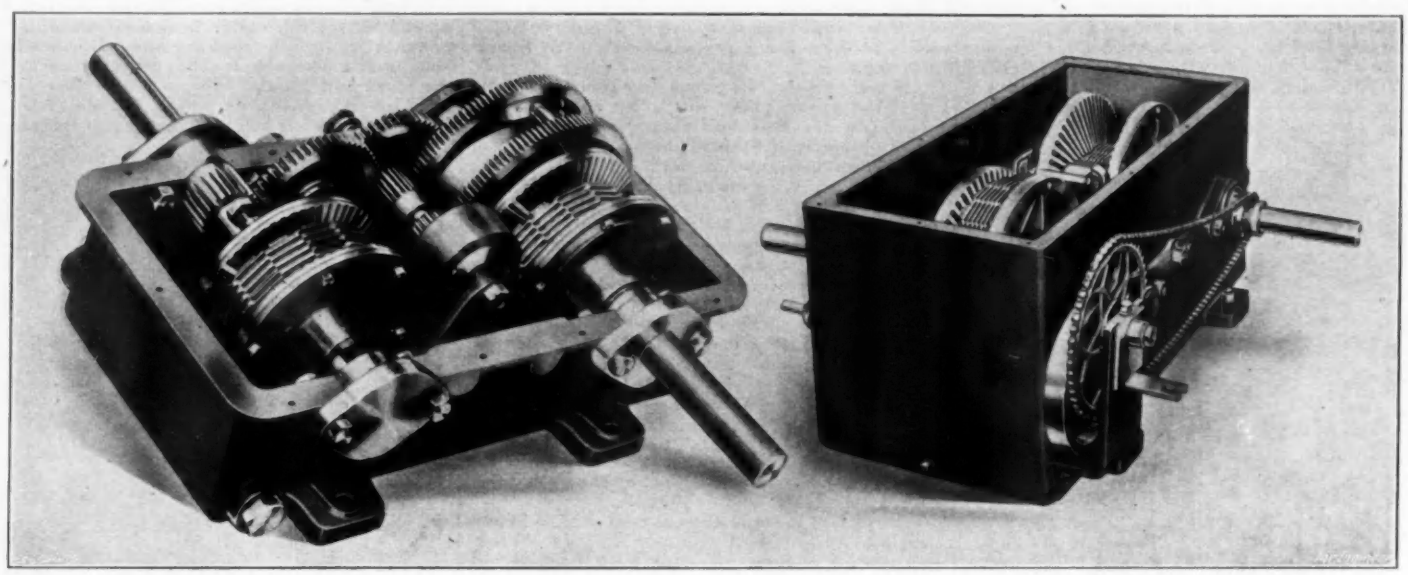


FIG. 24—ACETYLENE BREAKDOWN EQUIPMENT—ALLEN-LIVERSIDGE

exhibiting the breakdown equipment illustrated by Fig. 24. It is intended for use on urgent jobs, such as a breakdown, where welding or cutting may be required, and where in all probability no convenient source of light is available. It comprises a cylinder of dissolved acetylene equipped with a triple-branched

outlet, each branch being fitted with a regulating valve; the central, upright, branch supports a flare light of from 5000 to 10,000 candle power, while one of the side branches is connected with a portable light of 2000 candle-power by means of flexible piping. The opposite branch supplies acetylene, which may be used in conjunction with oxygen from another bottle to work a blow pipe. It is really a very simple piece of apparatus, but appears to us to be well worthy of attention by those contractors who may be occasionally called out on urgent breakdown work.

The exhibits of the P.I.V. Gear Syndicate, Ltd., 7, Prince's-street, Westminster, comprise three standard type totally enclosed gear-boxes of 10, 5, and 3 horse-power respectively with a speed variation in each case of the driven shaft as compared with the driving shaft of 4 : 1; a totally enclosed "P.I.V." gear-box which allows an infinite and continuous-



FIGS. 25 AND 26—INFINITELY VARIABLE GEAR BOXES—P.I.V.

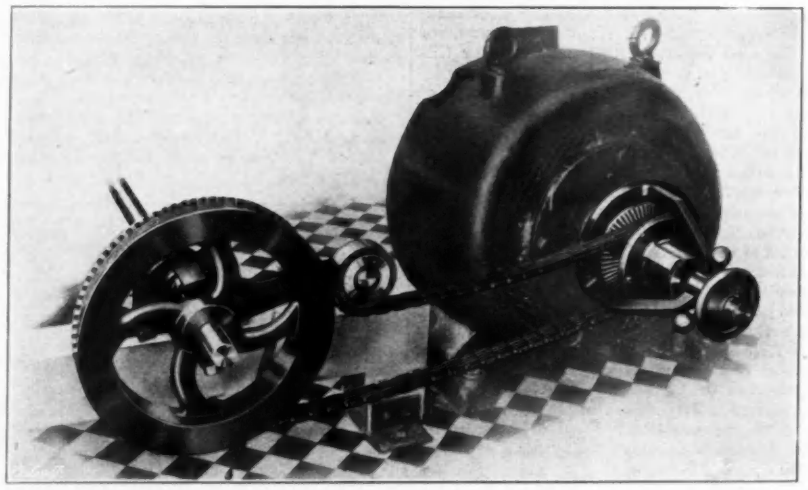


FIG. 27—OPEN MOTOR DRIVE—P.I.V.

variation in speed within any given range of the driven shaft as compared with the constant-speed driving shaft; an open "P.I.V." gear long-distance drive, specially intended for use in connection with electric motors; and a machine engaged in cutting the grooves of the patented "P.I.V." opposed conical disc faces. All these different exhibits are in motion, and several of them have glass tops so as to facilitate observation. We illustrate some of these gear-boxes in Figs. 25, 26, and 27.

It will be remembered that we have already given on August 27th, 1926, a detailed description of the general principles of the "P.I.V." (positively infinitely variable) gear, but since that description appeared a number of modifications have been introduced, among which there is the gear-box on view at the Fair, which allows continuous variation of the driven shaft. It is capable of transmitting 0·75 horse-power and is illustrated by Fig. 25. This gear is designed for the special requirements of an Italian firm of manufacturers of artificial silk spinning machinery, and the constant-speed shaft runs at 300 revolutions per minute, while the variable-speed shaft starts at 330 revolutions and then drops continuously and progressively to 270 revolutions per minute during fifty minutes. At the expiration of this period the driven shaft returns again to 330 revolutions per minute in not more than four seconds, the whole arrangement being entirely automatic. This result is obtained by mounting on the constant-speed driving shaft a pulley which does not expand except for a screw adjustment to give any desired set speed. The "P.I.V." chain then drives from this wheel to one mounted on the variable-speed shaft, which is provided with opposed conical disc pulleys, capable of a slight movement along the shaft in the usual manner, controlled by toothed gearing. The chain gradually rises in the grooves and progressively decreases the effective diameter of the driven pulley and therefore the speed. Included in the arrangement is a flat spring which is wound up in such a manner that at the expiration of fifty minutes it is released and pushes the opposed conical disc wheels closer together again, as in the original position, returning the speed, therefore, to 330 revolutions per minute. The makers inform us that stroboscopic tests on this box have shown that the estimated speeds are correct to within $^1/_{300}$th per cent., while it was found that the maximum departure from the theoretical straight-line speed variation was less than 0·3 per cent.

Another new modification is illustrated in Fig. 26, which constitutes an attachment to a "P.I.V." gear-box by means of which the power necessary to change the speeds is obtained from a constant-speed driving shaft. In this arrangement the raising or lowering of the large chain sprocket in its guides causes small pinions mounted on its shaft to engage either with an internal toothed wheel or an external toothed wheel mounted on the control spindle of the box. This gear is intended for use when very sensitive control is required and where the power available for operating the gear change is very small.

The four gear-boxes on view are mounted on one long bench, each driven from a line shaft, which in turn is driven by means of a standard "P.I.V." open chain drive from an electric motor, as shown in Fig. 27. The motor runs at a constant speed of 1000 revolutions per minute and the speed of the driven shaft can be varied infinitely between 250 and 500 revolutions per minute. We understand that a gear of this type suitable for motor cycle service is shortly to be put upon the market.

The Brooke Tool Manufacturing Company, Ltd., of Warwick-road, Greet, Birmingham, has a fine display of tools, such as drills, milling cutters, reamers, saws, &c., and a drilling machine in operation to demonstrate the rapid cutting qualities of its twist drills. On the occasion of our visit the motor driving the drilling machine was giving a little trouble, so it was not possible to demonstrate with the machine very well, but from all accounts these twist drills give remarkable performances, and one which we inspected, that had just come out of service, had been driven so hard that the lips were a deep blue colour and yet had not lost their edge. Some of the most interesting exhibits on this stand are, however, a collection of jigs for machining motor car engine parts, but as all jigs, naturally, are designed for individual jobs, it is hardly appropriate to describe them in detail in connection with an exhibition.

Ruston and Hornsby,, Ltd., of Lincoln, have a stand which is so remarkably similar to theirs at the last Fair that it is hardly necessary to go further than to say that it includes a single-cylinder horizontal oil engine of 130 B.H.P. shown running, a three-cylinder vertical engine of 45 horse-power, a little air compressing set for starting up the big engine, and a vertical boiler. Two other internal combustion engine firms with exhibits similar to those of last year are Fielding and Platt, Ltd., of Gloucester, with two oil engine of 30 and 12½ horse-power respectively; and Clayton and Shuttleworth, of Lincoln, who show a 50 horse-power and a 15 horse-power horizontal engine of the horizontal type, which was described recently in The Engineer, together with a little vertical set.